

**REMARKS**

Claims 1 and 3-21 are pending in the present application. In the Office Action mailed July 18, 2008, the Examiner rejected claim 1 under 35 U.S.C. §103(a) as being unpatentable over Mistretta et al. (USP 5,713,358) in view of Watts et al. (US Pub. 2003/0032877) further in view of Rose et al. (USP 6,815,952). The Examiner next rejected claims 3-5 under 35 U.S.C. §103(a) as being unpatentable over Mistretta et al. in view of Watts et al. further in view of Rose et al. and further in view of Jezzard, Peter “Physical Basis of Spatial Distortions in Magnetic Resonance Images.” in: Bankman, Isaac N., Handbook of Medical Imaging Processing and Analysis (San Diego, Academic Press, 2000), pp. 425-435 (hereinafter Jezzard). Claims 6, 11, 13, and 14 were rejected under 35 U.S.C. §103(a) as being unpatentable over Mistretta et al. in view of Rose et al. Claims 7-10, 12, and 15-21 were rejected under 35 U.S.C. §103(a) as being unpatentable over Mistretta et al. in view of Rose et al. and further in view of Jezzard. Claims 1 and 3-21 were rejected under 35 U.S.C. §103(a) as being unpatentable over Mistretta et al. in view of Jezzard.

**Claim 1 - Rejection under §103(a) over Mistretta et al. , Watts et al. and Rose et al.**

The Examiner rejected claim 1 under §103(a) as being unpatentable over Mistretta et al. in view of Watts et al. and further in view of Rose et al., stating that “Watts teaches: ‘waiting a predetermined period of time before sampling a next region of k-space if the next region of k-space is a center region...’” and that “[t]he image distortion effects resulting from the application of [ ] large gradients and time delay compensation for them are also well known in the art; particularly with regard to eddy-current compensation as noted by Rose.” *Office Action*, July 18, 2008, p. 7-8. The Examiner thus concluded that “it would have been obvious to one of ordinary skill in the art at the time of the invention to have included the step ‘and wherein the predetermined period of time is a function of peripheral region distance from the center region of k-space’ of Rose in the method of Mistretta in view of Watts in order to optimize SNR and avoid eddy-current induced image distortions as explicitly taught by Rose....” *Id.* at 8. Applicant respectfully disagrees. Specifically, Applicant believes that Watts et al. and Rose et al. fail to teach or suggest that which is called for in claim 1.

Watts et al. discloses a method/protocol for bolus-chase MR angiography. *Watts et al.* ¶24. A fluoroscopically triggered pulse sequence is used in which a recessed center-edge elliptical-centric view acquires data in the center of k-space 3 seconds into data acquisition. *Watts et al.*, ¶¶56-58. The 3 second shift of the acquisition of the center of k-space provides for better timing of the k-space center relative to the peak arterial concentration of a contrast agent

prior to venous return, thus giving better arterial visualization. *Id.* Watts et al., however, fails to teach or suggest that the method disclosed therein waits a predetermined period of time before sampling a next region of k-space if the next region of k-space is a center region of k-space, as called for in claim 1. Rather, Watts et al. merely discloses that the initial acquisition of the k-space center is shifted to a few seconds into the scan. During this “delay” that is present before k-space center acquisition, Watts et al. discloses that “the time prior to the acquisition of the [k-space] center is still used to acquire data, but not the very center of k-space.” *Watts et al.*, ¶96. Thus, there is simply no disclosure in Watts et al. that there is any predetermined period of time between the acquisition of data not in the center of k-space and the acquisition of data from the center region of k-space. The Examiner has read more into the reference than what is there - there is no “delay” or predetermined period of time that passes between acquisition of regions of k-space in Watts et al., but only a shift in the acquisition of data from the center region of k-space that is immediately preceded by acquisition of data not in the center of k-space. Furthermore, no other “delays” are taught or suggested in Watts et al. other than the initial shifting of the first sampling of the k-space center. Therefore, Watts et al. fails to teach or suggest what is specifically called for in claim 1, that being a method that includes the step of sampling peripheral regions of k-space and then waiting a predetermined period of time before sampling a next region of k-space if the next region of k-space is a center region of k-space.

Referring now to Rose et al., a method of eddy current compensated diffusion imaging using MR is disclosed therein. *Rose et al.*, Col. 1, lns. 41-43. A spin echo signal is obtained in a readout time window by excitation of a nuclear resonance signal and gradient pulses are applied to avoid distortions in a generated image that are due to eddy current production. *Rose et al.*, Col. 1, ln. 43 to Col. 2, ln. 17. The diffusion gradient pulses have a polarity, which is alternated between successive gradient pulses such that the totality of the gradient pulses having a gradient time integral between a time of said excitation and of the center of k-space that is equal to zero. *Id.* Rose et al., however, fails to teach or suggest a delay of a predetermined period of time between sampling of k-space regions that is a function of peripheral region distance from the center region of k-space, as is called for in claim 1. Rather, Rose et al. merely teaches a method of eddy current compensation in which diffusion gradient pulses are applied having alternating polarities and having a total gradient time integral of zero. The method taught in Rose et al. is a method that avoids problems caused by eddy currents by negating the effects of these eddy currents via gradients of opposite polarity being applied and not by varying a delay time based on peripheral region distance from the center of k-space.

With respect to Rose et al., the Examiner stated that the reference discloses “formulae which directly show that larger gradients correlate to moving out farther from k-space center and this larger distance is associated with a larger delay ( $t_s$ ) in returning to k-space center in order to compensate for the noise and eddy current effects” *Office Action*, supra at 4. To the extent that Rose et al. does disclose any “delay”, this delay ( $t_s$ ) is in reference to the delay before the center of an echo or the center of k-space when an EPI readout method is used. *Rose et al.*, Col. 7, lns. 34-45. This delay before the center of the echo or the center of k-space when an EPI readout method is used is not a delay for waiting a predetermined period of time before sampling a next region of k-space if the next region of k-space is a center region of k-space.

In rejecting claim 1, the Examiner further stated that “it is a well known fact in the art that large gradients induce image distortion effects that are time associated” and that “[t]herefore, Rose would be found by those of ordinary skill in the art to teach provide [sic] the missing elements or limitations with regard to delay and the associated distance from k-space center.” *Office Action*, supra at 4. Applicant respectfully disagrees and objects to the Examiner’s reliance on what is “well-known” in the art. Applicant thus traverses the Examiner’s reliance on well-known art and requests that the Examiner provide a reference for such a teaching. Additionally, Applicant believes that Examiner’s reliance on what is well-known in the art rather than on Rose et al. for teaching a delay before sampling the center of k-space of a predetermined period of time between sampling of k-space regions that is a function of peripheral region distance from the center region of k-space is indicative of Rose et al.’s failure to teach such an element. That is, the Examiner apparently recognizes Rose et al.’s failure to teach or suggest what is called for in claim 1, and thus must rely on what is asserted to be “well-known” in the art.

In light of the above, Mistretta, Watts et al., and Rose et al., alone or in combination, fail to teach or suggest that which is called for in claim 1. Therefore, for at least the reasons set forth above, claim 1 and the claims dependent therefrom are patentably distinct from the combination of cited references.

**Claims 6 & 14 - Rejection under §103(a) over Mistretta et al. in view of Rose et al.**

The Examiner rejected claims 6 and 14 under §103(a) as being unpatentable over Mistretta et al. in view of Rose et al. Each of claims 6 and 14 calls for, in part, a computer programmed to delay sampling of the center of k-space as a function of the distance an immediately preceding sampled peripheral region is from the center of k-space. In rejecting the claims, the Examiner stated that Rose discloses the “dependence of k-space MR signal sampling

on the distance of ‘an immediately preceding sampled peripheral region is from the center region....’” *Office Action*, supra at 13. Applicant respectfully disagrees.

As set forth in detail above, Rose et al. discloses a method of eddy current compensated diffusion imaging in which gradient pulses are applied to avoid distortions in a generated image that are due to eddy current production. *Rose et al.*, Col. 1, ln. 43 to Col. 2, ln. 17. The diffusion gradient pulses have a polarity, which is alternated between successive gradient pulses such that the totality of the gradient pulses having a gradient time integral between a time of said excitation and of the center of k-space is equal to zero. *Id.* Rose et al., however, fails to teach or suggest a delay of a predetermined period of time between sampling of k-space regions that is a function of peripheral region distance from the center region of k-space, as is called for in claims 6 and 14. Rather, Rose merely teaches a method of eddy current compensation in which diffusion gradient pulses are applied having alternating polarities and having a total gradient time integral of zero.

To the extent that Rose et al. does disclose any “delay” this delay ( $t_s$ ) is in reference to the delay before the center of an echo or the center of k-space when an EPI readout method is used. *Rose et al.*, Col. 7, lns. 34-45. There is no teaching or suggestion that the delay  $t_s$  is based on a function of the distance of an immediately preceding sampled peripheral region from the center of k-space.

In addition to Rose et al.’s failure to teach that which is called for in claims 6 and 14, Mistretta et al. also fails to teach or suggest the elements called for in those claims. That is, Mistretta et al. also fails to teach or suggest a delay of a predetermined period of time between sampling of k-space regions that is a function of peripheral region distance from the center region of k-space, and the Examiner has admitted such by stating that Mistretta et al. does not teach any delaying of sampling of k-space regions. *See Office Action*, supra at 12-13. Therefore, as neither of the cited references teach or suggest the delaying of sampling of the center of k-space as a function of the distance an immediately preceding sampled peripheral region is from the center of k-space as called for in each of claims 6 and 14, the combination of cited references fail to teach all the elements of those claims. As such, Applicant believes that claims 6 and 14, and the claims dependent therefrom, are patentably distinct from Mistretta et al. and Rose et al.

**Claims 1, 6, & 14 - Rejection under §103(a) over Mistretta et al. in view of Jezzard**

The Examiner also rejected claims 1, 6, and 14 under §103(a) as being unpatentable over Mistretta et al. in view of Jezzard, stating that “Jezzard teaches the application of a delay which is determined by applying dummy acquisitions or scans in order to allow spins to have reached a steady state when the image signal is detected and to curtail non-frequency-encoded [noise]” and that “it would have been obvious to one of ordinary skill in the art at the time of the invention to have included the predetermined period of time delay of Jezzard in the system and method of Mistretta in order to allow for spin steady state conditions and reduction of region-derived image noise as taught by Jezzard.” *Office Action*, supra at 19-20. Applicant respectfully disagrees. Specifically, Applicant believes that Mistretta et al. and Jezzard, either alone or in combination, fail to teach or suggest that which is called for in claims 1, 6, and 14.

In rejecting claims 1, 6, and 14, the Examiner stated that “Mistretta teaches all claim limitations for claims 1, 6, and 14 with the exception of ‘wherein the predetermined period of time is a function of peripheral region distance from the center region of k-space’.” *Office Action*, supra at 19. The Examiner thus relied on Jezzard for teaching the application of a delay period that is a function of peripheral region distance from the center region of k-space, stating that “specific pages (p.434) and mathematical equations (11-13) from the Jezzard reference that detail a k-space region correlated delay for reduction of noise and maintenance of spin steady state.” *Office Action*, supra at 2. Applicant respectfully disagrees with the rejection.

While Applicant agrees with the Examiner’s statement that Mistretta fails to teach “waiting a predetermined period of time that is a function of peripheral region distance from the center region of k-space,” Applicant would also point to the Examiner’s characterization of Mistretta as failing to teach “waiting a predetermined period of time before sampling a next region of k-space if the next region of k-space is a center region of k-space.” See *Office Action*, supra at 7. In addition to the failure of Mistretta to teach waiting a predetermined period of time before sampling a next region of k-space if the next region of k-space is a center region of k-space, Jezzard also fails to teach waiting a predetermined period of time before sampling a next region of k-space if the next region of k-space is a center region of k-space. That is, Jezzard, merely teaches that an available longitudinal magnetization can be controlled based on a repetition time (TR) between spin excitations. *Jezzard*, p. 434. Jezzard states that a TR period can be maintained at a constant value or varied based on a measured cardiac period (i.e., based on cardiac gating). *Id.* Additionally, in applications where a very short TR time is used, dummy acquisitions/excitations of the spin system can be applied such that the spins attain a steady-state

starting magnetization. *Id.* There is simply no teaching or suggestion in Jezzard, however, of determining whether to wait (i.e., apply a delay) a predetermined period of time before sampling a next region of k-space if the next region of k-space is a center region of k-space. Jezzard does not teach making a determination as to whether a “next region of k-space is a center region of k-space.” In fact, as shown in Eqn. 11 of Jezzard, a retrospect analysis of a TR time is performed ( $TR_{j-1}$ ), and there is no prospective examination of a next (i.e., to be sampled) k-space region. Thus, there is no characterization made in Jezzard of whether a “next region of k-space is a center region of k-space.” For this reason alone, the combination of Mistretta and Jezzard fails to teach or suggest that which is called for in each of claims 1, 6, and 14.

Additionally, Jezzard (alone or in combination with Mistretta) fails to teach the application of a delay period that is a function of peripheral region distance from the center region of k-space. In fact, the only implementation for which Jezzard teaches the use of dummy acquisitions/excitations is with respect to a “rigorously constant” TR time. *Jezzard*, p. 434, paragraph preceding Eqn. 12 (emphasis added). Thus, Jezzard does not teach or suggest waiting a predetermined period of time before sampling a next region of k-space that is a function of peripheral region distance from the center region of k-space. Instead, even when dummy acquisitions/excitations are implemented in Jezzard, the TR time remains constant. Jezzard only teaches that, initially, a number of dummy acquisitions/excitations can be selected that are sufficient to allow for spins to attain a steady-state starting magnetization. Once this number of dummy acquisitions/excitations is selected, it remains constant and the TR time does not vary.

The Examiner has provided no indication of a teaching in Jezzard of (1) waiting a predetermined period of time before sampling a next region of k-space if the next region of k-space is a center region of k-space, or (2) the application of a delay period that is a function of peripheral region distance from the center region of k-space, which was the Examiner’s stated purpose for combining Jezzard and Mistretta et al. The combination of Mistretta et al. and Jezzard simply does not teach or suggest that which is called for in claims 1, 6, and 14. As such, claims 1, 6, and 14, and the claims dependent therefrom, are patentably distinct over the cited references.

Therefore, in light of at least the foregoing, Applicant respectfully believes that the present application is in condition for allowance. As a result, Applicant respectfully requests timely issuance of a Notice of Allowance for claims 1 and 3-21.

Applicant appreciates the Examiner's consideration of these Remarks and cordially invites the Examiner to call the undersigned, should the Examiner consider any matters unresolved.

Respectfully submitted,

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**General Authorization and Extension of Time**

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 07-0845. Should no proper payment be enclosed herewith, as by credit card authorization being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 07-0845. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extensions under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 07-0845. Please consider this a general authorization to charge any fee that is due in this case, if not otherwise timely paid, to Deposit Account No. 07-0845.

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